CLAIMS

What is claimed is:

1. A method of varying the position of a micromachined electrostatic actuator using a pulse width modulated (PWM) pulse train, comprising:
applying one or more voltage pulses to the actuator wherein a voltage changes from a first state to a second state and remains in the second state for a time Δt_{pulse} before returning to the first state; and
varying the position of the actuator by varying the time Δt_{pulse}.

2. The method of claim 1, further comprising, determining a position of the actuator by measuring a capacitance of the actuator when the voltage changes state.

3. The method of claim 2, wherein the capacitance is measured by integrating a current to the actuator with an integrator and converting the integrated current to a digital word with an analog-to-digital converter (ADC).

4. The method of claim 3, wherein the integrator measures charge transferred during a transition of one or more of the voltage pulses.

5. The method of claim 3, wherein the time Δt_{pulse} is greater than or equal to the sum of time-delay of the integrator Δt_s and an conversion time of the ADC Δt_{ADC}.

6. The method of claim 1, wherein a frequency of the PWM signal is above a mechanical bandwidth of the actuator.

7. The method of claim 1, wherein the time t_{pulse} is varied by modulating the duty cycle of a fast pulse train with a slower base-band signal.

8. A method for measuring a position of a micromachined electrostatic actuator, comprising:
applying one or more voltage pulses to the actuator wherein a voltage changes from a first state to a second state and remains in the second state for a time Δt_{pulse} before returning to the first state;
measuring a capacitance of the actuator when the voltage changes state;
and determining a position of the actuator from the capacitance.

9. The method of claim 8, wherein the capacitance is measured by integrating a current to the actuator with an integrator and converting the integrated current to a digital word with an analog-to-digital converter (ADC).

10. The method of claim 9, wherein the integrator measures charge transferred during a transition of one or more of the voltage pulses.

11. The method of claim 9, wherein the time t_{pulse} is greater than or equal to the sum of time-delay of the integrator Δt_s and an conversion time of the ADC t_{ADC}.

12. The method of claim 8, wherein a frequency of the PWM signal is above a mechanical bandwidth of the actuator.

13. The method of claim 8, wherein the time t_{pulse} is varied by modulating the duty cycle of a fast pulse train with a slower base-band signal.

14. An apparatus for varying the position of a MEMS device, comprising:
a pulse width modulation generator coupled to the MEMS device
an integrator coupled to the MEMS device and an analog-to-digital converter coupled to the integrator.

15. The apparatus of claim 14, wherein the integrator measures charge transferred during a transition of a pulse from the pulse width modulation generator.

16. The apparatus of claim 14, wherein the integrator includes
an amplifier, having at least one input and an output,
an integrator capacitor coupled to the MEMS device,
a hold capacitor,
a compensation voltage generator, and
first, second and third switches,
wherein the hold capacitor is coupled to the MEMS device,
wherein the hold capacitor is coupled to the input of the amplifier
wherein the first switch selectively couples the hold capacitor to the compensation voltage generator or the output of the amplifier,
wherein the second switch selectively couples input of the amplifier to the output of the amplifier,
wherein the third switch selectively couples MEMS device and the hold capacitor to ground.